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Distribution and habitat of the land snail *Tasmaphena lamproides* (Pulmonata: Rhytididae) in Tasmania

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The carnivorous snail *Tasmaphena lamproides,* believed to be endemic to northwest Tasmania and far southern Victoria, has been considered rare. A survey in the Togari forest block in northwest Tasmania suggests that the species occurs in a wide range of forest habitats but requires deep leaf litter to survive, and is more frequent in the north of the block. Knowledge gained from this survey, combined with known records, suggests a range of at least 25,000 hectares and an improved outlook for the species.

Introduction

Tasmaphena lamproides (Cox, 1868) (Gastropoda: Pulmonata: Rhytididae) is a large carnivorous land snail considered to be rare. Carnivorous snails are generally less numerous than snails at lower trophic levels. However, *T. lamproides* also appears to have a restricted distribution. Smith and Kershaw (1981) recorded it from only five 10 km grid squares in northwest Tasmania.

In this paper we collate the distribution records for *T. lamproides* and report on the habitat requirements of the species revealed from a detailed survey of part of its range.

Previous Distribution Records

Tasmaphena lamproides was discovered by Cox in the late 1860s and described (as *Helix lamproides*) by him in 1868. Petterd (1879) suggests that Circular Head was the type locality. There were a number of collections of the species during the 1870s, but it is difficult to determine by whom these were made, since most appear only in monographs. Petterd listed the localities of Table Cape, Circular Head and Duck River, with a note that the North West Bay locality given by Legrand in 1871 was almost certainly an error resulting from mis-labelling.

The Table Cape record is apparently due to Petterd. He notes that it occurred under logs in "dense fern-tree scrubs" at the Duck River (probably at Smithton or slightly further south) but at a drier locality at Circular Head. However, he gives no detail of the habitat at the Table Cape site, nor does any other author, and there has been no other record within 30 km of Table Cape. Furthermore, Ron Kershaw (pers. comm.) notes that records given by Petterd are sometimes unclear due to insufficient or confused labelling. Under these circumstances the record is highly dubious.

Petterd and Hedley (1909) state that *T. lamproides* "is strictly confined to the north-western scrubs where it is not uncommon" and also recorded some very large specimens from Montagu River. Specimens which have since been found near the southern parts of the Montagu River are far smaller

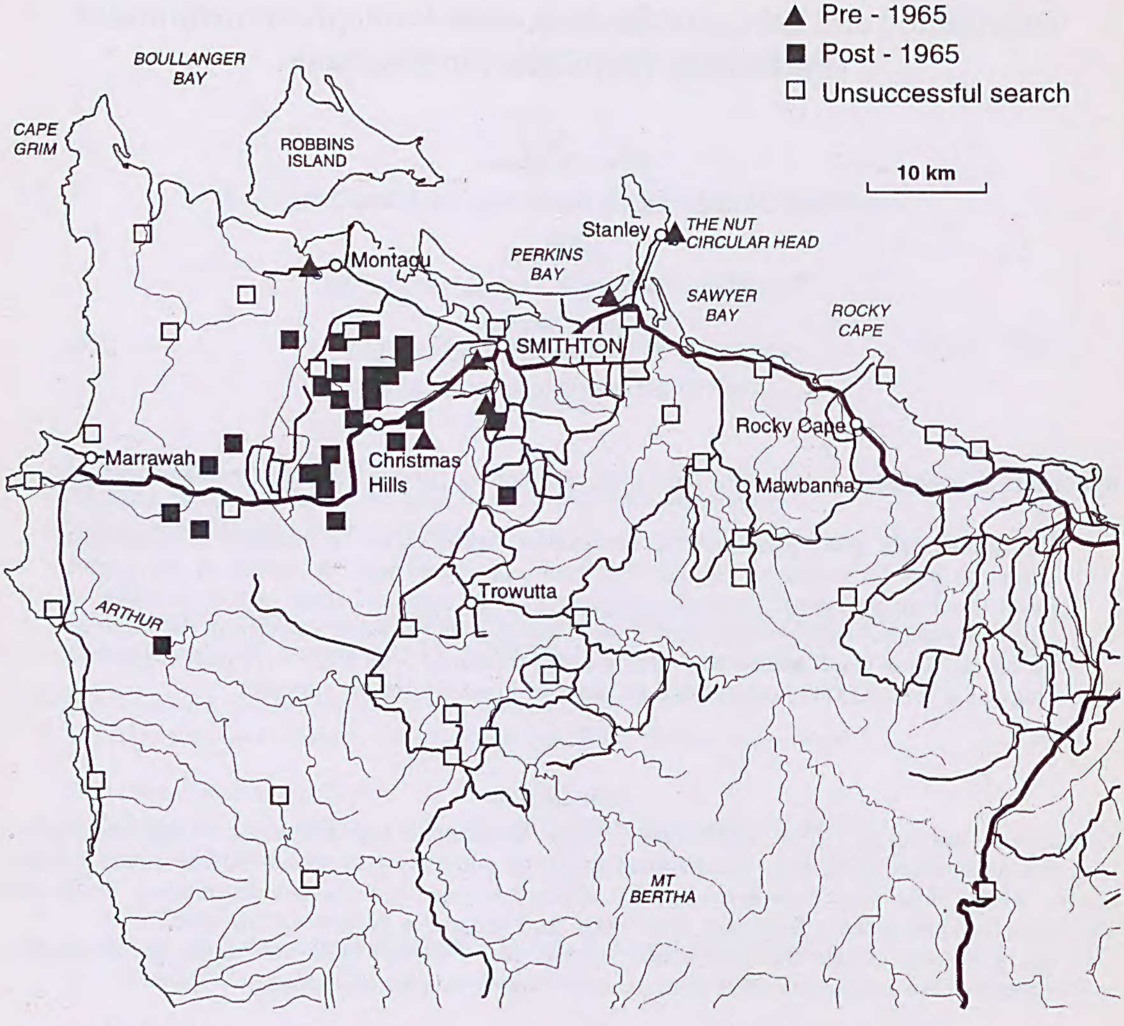

Figure 1. Distribution records for *T. lamproides* and searches undertaken for the species which have been unsuccessful. The old record from Table Cape is considered dubious (see text) and has not been included.

than the suggested size of 29 mm (shell width). This suggests that the large specimens may have come from the northern end of the river.

Kershaw (pers. comm.) suggests the record from Circular Head may have been inland (e.g. Christmas Hills). This would not be surprising as early locality data were frequently imprecise. However, the past existence of the species near The Nut is confirmed by a specimen collected by B.C. Mollison at West Inlet in 1963 and held in the collections of the Tasmanian Museum, Hobart. This specimen is a whitened dead shell which may have been preserved by sand for some decades prior to collection. As it was found under a stone, the chance of it being accidentally brought to the area is remote. Thus it seems that *T. lamproides* was present there at some time in the past. The habitat now appears unsuitable and attempts to find it around The Nut since have failed.

Kershaw (pers. comm.) recorded the species from Christmas Hills "on hillside above the swamp in wet forest litter" in 1957. He indicates that he found it very difficult to find in the northwest and did not find many specimens.

During December 1988 and September 1991 live *T. lamproides* were recorded by K.B. at Turk's Landing (Arthur/Frankland Rivers, AMG 3128 54503, 25/12/88), Eldridge Road (3266 54619, 25/12/88) and near Jones Plain (3343 54708, 4/10/91). At all these sites the species was very difficult to find.

Bob Mesibov (pers. comm.) has found the species a number of times in recent years. Several of these records are from the northern part of the Togari forest block. Other records are from the Christmas Hills/Jones Plain area (3341 54702, 26/8/92), and from two different areas of Welcome Swamp (3146 54630, 9/7/92) (3169 54620, 25/9/92).

A number of apparently suitable areas in the northwest do not appear to support *T. lamproides*. It has not been found at Balfour, and attempts by K.B. to find it in the Sumac Loop area have yielded none in over 12 hours searching. Many areas around Black River and Rocky Cape have been searched unsuccessfully by various collectors. Distribution maps for other species in Smith and Kershaw (1981) indicate that some localities in the extreme northwest (Woolnorth–Mt Cameron–Montagu area) have been searched without success. *Tasmaphena lamproides* has also not been found on King Island despite some collecting effort.

T. lamproides also occurs on Wilson's Promontory, Victoria. S. A. Clark (pers. comm.) of the Australian Museum (Sydney) found it fairly easily on four separate visits. Clark confirms that Victorian and Tasmanian specimens are very similar. Some other Victorian records are rumoured but are unconfirmed by specimens. The distribution across Bass Strait is slightly unusual as several commoner medium to large Tasmanian snails are endemic.

Methods

An intensive survey of *T. lamproides* was undertaken in the Togari Forest block, an area of around 8600 ha northwest of Christmas Hills in northwest Tasmania (Fig. 2). Elevation varies between 30–100 m and Togari mudstone (yellow clay) soils predominate. Most of the area is dominated by *Eucalyptus obliqua* with Blackwood (*Acacia melanoxylon*) dominating in the gullies. The area was cut-over in the 1950s and 60s and so the old growth present is mixed with regrowth of differing densities depending on the extent of past disturbance. This old growth covers about 25% of the area, with non-eucalypts, including Blackwood, covering 15%, with the rest being mainly regrowth eucalypt. The undergrowth is dominated by the shrubs *Pomaderris apetala*, *Acacia mucronata*, *Zieria arborescens*, *Oleria argophylla*, *Leptospermum* spp., *Melaleuca* spp., the tree fern *Dicksonia antarctica* and the sedges *Gahnia grandis* and *Lepidosperma elatius*. The rainforest trees *Nothofagus cunninghamii* and *Atherosperma moschatum* also occur on some sites.

Fieldwork was conducted between 7–11 and 14–17 September 1992. Twenty-nine plots were surveyed (by Kevin Bonham and Michael Mahoney). Each plot was a circle of radius 15 m. A larger sampling area would have involved greater searching time at each site and would have prevented a sufficient range of sites from being covered, while smaller plots would not have yielded sufficient numbers of *T. lamproides* to enable meaningful comparisons between sites and would have led to excessive time wastage in travelling between sites. Twenty-nine sites were selected so as to sample the range of vegetation types and spread plots across the block. Time taken to search a plot and identify specimens varied from 70 to 120 minutes according to the amount of suitable shelter present, which was greatest on gently sloping sites and sites with a large number of small trees. Identification of *T. lamproides* was straight forward except for one specimen which caused some confusion because it lacked the lateral keel present strongly in all other known individuals. Specimens of *T. lamproides* were classed as alive or dead and as adult or juvenile. Specimens were classified as "adult" if shell width was 14 mm or greater. Full size is around 21 mm. In the absence of any anatomical work on the species this was thought to provide a better estimate than whorl count.

Site details recorded included grid reference, age of forest (whether regrowth or old growth, and estimated age if the former), dominant plant species present, degree and direction of slope. Forest age was estimated in the field and checked against forest age maps held by Forestry Tasmania. Every

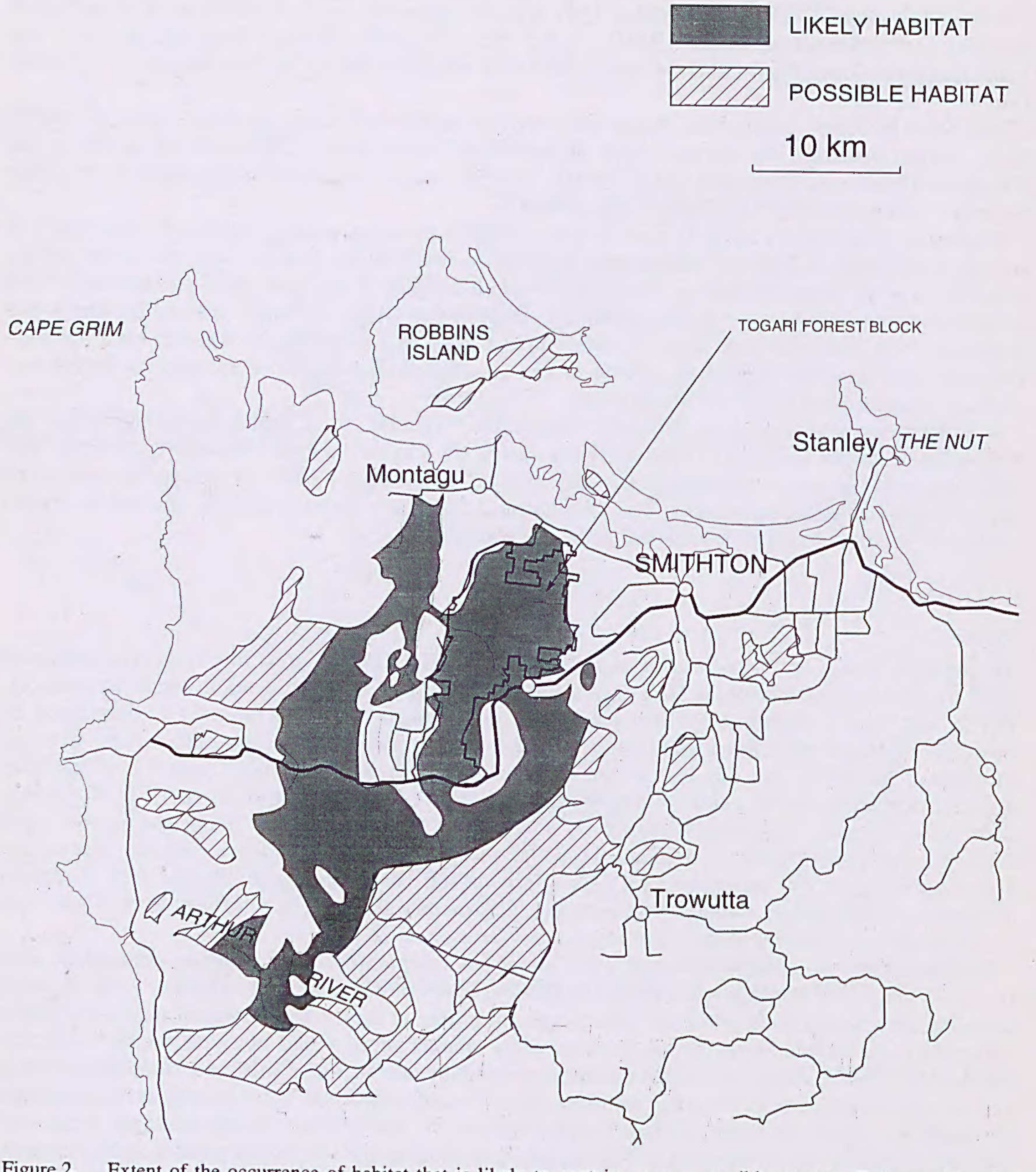

Figure 2. Extent of the occurrence of habitat that is likely to contain, or may possibly contain, *T. lamproides*. The intensive study area (Togari forest block) to the west of Smithton is outlined in black.

attempt was made to ensure undergrowth conditions were representative of the area selected, but at some sites this was difficult to do.

All available shelter was searched, including the undersides of logs and stones, piles of sufficiently deep leaf litter (especially around the bases of trees), and the insides of logs sufficiently decomposed to be broken apart. It is likely that some specimens were missed, particularly those sheltering under logs too large to move. However, of the many logs that required any persistent effort to move, only one had a *T. lamproides* under it and the specimen was not far away from the edge of the area covered by the log. *T. lamproides* is not known to climb trees.

Other mollusc species encountered were also counted and numbers of potential prey species and predatory species (which may compete with *T. lamproides*) were correlated with numbers of *T. lamproides*. Both total numbers and numbers of live *T. lamproides* were used in the analysis. Numbers of live adults can be prone to weather-related variations in crypticity and to small sample size when used alone. Numbers of dead adults may represent relics of past populations under different ecological conditions, while juvenile numbers may be unsuitable due to variation in juvenile mortality.

Correlations were determined using either Pearsons or Spearman rank correlation coefficients. Stepwise multiple regression was used to investigate linear relationships between a variable and several others. Two means were compared with t-tests.

Results

Distribution

Sites where *T. lamproides* has been recorded, including those from the present study and subsequent records, are shown in Fig. 1. In many cases, particularly older records, the locality shown is only approximate. Successful searches very close to each other have been shown as one record, while some unsuccessful searches very close to successful ones have also been omitted. The unsuccessful searches shown are certainly not all that have occurred in the area shown, but are included to give some indication of likely restrictions upon the range of the species. The area around Mt Bertha has been extremely poorly searched but the large number of recorded non-occurrences north, west and northwest of that area suggest it is unlikely that *T. lamproides* occurs there.

An assessment of the likely range of *T. lamproides* is provided in Fig. 2. The species has been considered likely to occur in areas of suitable habitat close to and continuous with recent records. Areas of suitable habitat where the evidence is unclear are also indicated. For instance there has been no searching in the scrub areas on Robbins Island. The biggest areas of uncertainty are around the southern end of the Montagu River, where over 100 km2 of suitable habitat has never been searched. The record from the Arthur/Frankland junction suggests the species may occur this far south. Around 25,000 hectares of habitat are considered likely to contain *T. lamproides*, with at least another 20,000 hectares unclear. About 7,000 hectares west of the northern part of the Togari block probably contains good populations of *T lamproides* but is owned by North Forest Products and future land use here is uncertain. A few small areas are privately owned but these are not likely to be of great significance. The remaining likely range of the species is largely within State forest.

Habitat Use

A total of 17 native and two introduced molluscs were recorded from the sampled plots in the Togari forest block. Numbers (including live and dead specimens) of each species (listed according to family) are as follows:

RHYTIDIDAE: *Victaphanta milligani* 174, *Tasmaphena lamproides* 82, *Prolesophanta dyeri* 8, *Prolesophanta nelsonensis* 2.

CHAROPIDAE: *Pernagera kingstonensis* 5, *Allocharopa legrandi* 15, *Discocharopa mimosa* 1, *Roblinella gadensis* 1, *Oreomava johnstoni* 6, *Bischoffena bischoffensis* 1, *Thryasona diemenensis* 6, *Stenacapha hamiltoni* 485.

PUNCTIDAE: *Paralaoma caputspinulae* 1, *Pedicamista* sp. 2, *Trocholaoma parvissima* 1.

CYSTOPELTIDAE: *Cystopelta bicolor* 5.

HELICARIONIDAE: *Helicarion cuvieri* 142.

LIMACIDAE: *Deroceras reticulatum* (Introduced) 1.

ARIONIADE: *Arion intermedius* (Introduced) 3.

Some species, especially *Cystopelta bicolor*, occur in different microhabitats to that of *T. lamproides*, and thus the numbers recorded are not a true indication of the relative frequencies of the species. The semi-slug *Helicarion* (a dietary item of *T. lamproides*) appears to be quite common but only 3 of the 142 seen were alive.

T. lamproides did not occur at any site in particularly great numbers. The maximum recorded at a site was ten, four of which were live specimens. A large carnivorous snail has considerable demands for food and thus cannot occur in very large numbers unless food is abundant. However, *T. lamproides* is clearly one of the more numerically significant species in the block. Only two other species, namely *V. milligani* and *S. hamiltoni*, were more often found alive. Eighty-two (8.75%) of 937 native molluscs found were *T. lamproides*, and on sites potentially suitable for it, it averaged 11.3% of all snails found. Although this figure is inflated by the fact that searching effort was concentrated on this species, it still compares very favourably with the equivalent figures for related species, such as *T. sinclairi* which accounts for a mean 7% in the habitats in other areas where it is present (K. Bonham, unpubl. data). The evidence thus suggests that *T. lamproides* is no rarer than one would expect of a large carnivorous snail in such habitat.

Tasmaphena lamproides occurred at 23 of the 29 sites surveyed. Of 82 specimens found there were 20 live adults and 11 live juveniles, 31 dead adults and 20 dead juveniles. The majority of specimens were found associated with logs or accumulations of litter (Table 1). Most dead specimens were found under logs or in other microhabitats which suggested they had lived in the area, and only a small number were particularly worn or decomposed. Two sites had large numbers (five and six) of dead shells only. Live specimens occurred at 15 sites. The number of dead shells at a site was not correlated with the number of live animals found but the number of live adults was correlated with the number of live juveniles ($r_s = 0.48$, $p<0.05$).

At the two sites where only a single dead shell was found it is likely that these shells had been transported to the sites by a bird or mammal as both were badly damaged in a manner consistent with predation and they were not under logs or stones. *T. lamproides* was considered absent from these sites in subsequent analyses.

Sites where invertebrates populations appeared to be low were generally poor sites for *T. lamproides*. The range of invertebrates included in the diet of *T. lamproides* is not known. During

Table 1. Occurrence of *Tasmaphena lamproides* in different microhabitats from sites surveyed in the Togari Forest Block west of Smithton in northwest Tasmania.

Microhabitat	Live Adult	Live Juvenile	Dead Adult	Dead Juvenile	TOTAL
Under logs	6	1	12	3	22
In rotten logs	1	–	–	–	1
Litter around logs	2	1	2	4	9
Litter at base of *Dicksonia* fern	5	1	1	–	7
Litter at base of *Pomaderris*	4	3	5	1	13
Litter at base of *Olearia*	–	3	–	1	4
Litter at base of blackwood	–	–	–	1	1
Litter at base of eucalypt	–	–	1	1	2
Litter in ditches and depressions	2	1	7*	3	13*
Litter in the open	–	1	1	6	8
On open ground	–	–	2*	–	2*

* Includes one badly damaged shell possibly transported to the site by animals.

the survey, two live adult *T. lamproides* were observed feeding on *S. hamiltoni*, a very common charopid snail. The only other non-predatory snail species present which occurred in reasonable numbers and was greater than 3 mm in size was *H. cuvieri*. Several dead *H. cuvieri* specimens were in a crumpled condition consistent with predation by *Tasmaphena*. Combined numbers of *S. hamiltoni* and *H. cuvieri* were used as an index of snails potentially available as prey. Total numbers of *T. lamproides* ($r = 0.51$, $p<0.01$), but not numbers of live individuals, were significantly correlated with the combined numbers of *S. hamiltoni* and *H. cuvieri*. *T. lamproides* was absent from a site where a large number (39, including 23 alive, 16 of those adult) of *V. milligani* (another predatory species of mollusc) was found. The number of *V. milligani* was significantly negatively correlated with total numbers of *T. lamproides* ($r = -0.39$, $p<0.05$) but not with the number of live *T. lamproides*. A multiple regression of total numbers of *T. lamproides* (but not number of live *T. lamproides*) against numbers of predators and non-predatory snails was significant ($F(2,26)=8.6$, $p<0.01$; $r = 0.63$).

Total number of *T. lamproides* = 0.096 P - 0.093 Vm + 1.23 where P = numbers of prey (*S. hamiltoni* and *H. cuvieri*) and Vm = numbers of *V. milligani*.

The apparent lack of invertebrate prey and associated lack of *T. lamproides* populations often appeared to be associated with poor development of the litter layer. The litter layer is destroyed by hot regeneration burns undertaken after logging or by intense wildfires but builds up again as the regrowth forest ages. To examine the effects of forest age on *T. lamproides,* populations in young regrowth (<60 years) were compared with those in older forest (> 60 years). One of the mature forest sites was extremely swampy and it is likely that the ground would have been underwater for much of the year. The absence of the species here was probably not associated with lack of litter and this site was excluded from this analysis. Total numbers of *T. lamproides* in young regrowth sites (1.00±1.26 (X±SD))was significantly less ($t = 2.12$, df=26, $p<0.05$) than for older forest (3.36±2.56).

Populations densities (live and dead) of *T. lamproides* in older forest in the north of the Togari block (north of around the 76 grid line) (5.25±2.76, N=8) were significantly greater ($t=3.21$, df=21, $p<0.01$) than those in older forest in the southern section (2.13±1.88, N=15).

Discussion

The lack of any correlation between numbers of live animals and dead shells suggests that population numbers at a site may fluctuate dramatically. For example, there were exclusively numerous dead shells at two sites which showed no unusual preservation conditions. Population explosion and die-off has been observed in many Tasmanian snails including *V. milligani* (K. Bonham unpubl. data). With this in mind, we consider that total numbers more reliably indicate habitat quality.

The basic needs of *T. lamproides* would encompass adequate food supplies including calcium for shell growth, moisture, shelter from predators, and protection from adverse weather. *T. lamproides* was found to be absent from sites with poor litter development and/or invertebrate populations. This is probably related to a low abundance of food as suggested by the correlation between numbers of *T. lamproides* and numbers of nonpredatory snails. Little is known regarding the prey of *T. lamproides*, and thus comprehensive data on food availability could not be gathered to determine how the abundance of prey affected the species. The small number of shells found that had been damaged by vertebrates suggests a lower rate of predation from vertebrates than for some other large Tasmanian snails such as *Anoglypta, Caryodes* and *Bothriembryon*.

The absence of *T. lamproides* from one site was probably related to the swampy conditions and its absence from an extremely sandy site could have been related to a calcium deficiency in the soil or to the lack of shelter in the form of logs or litter accumulations. There was a significant negative correlation between numbers of *T. lamproides* and other predatory snails, and *T. lamproides* was absent from a site where the other major predatory species, *V. milligani*, was abundant. This suggests that competition plays a role in influencing population levels of *T. lamproides*. However, since the number of *V. milligani* was only significantly negatively correlated with total numbers of *T.*

lamproides and not with numbers of live individuals, it is possible that the significant correlation may be due to the destruction of dead shells by other predatory snails as a way of obtaining calcium. A specimen of *V. milligani* was observed eating a *T. lamproides* shell once during the survey. *Victaphanta milligani* is known to eat worms (B. Mesibov, pers. comm.) and can travel into the soil for some distance where a hole of some form already exists. It was frequently observed entering holes too small for an adult *T. lamproides* to fit into.

T. lamproides was absent from young silvicultural regrowth. This may be due to low levels of litter and associated low abundances of invertebrates in these forests (Madden *et al.* 1976, Neumann 1991). However, it appears that logging may not have a detrimental effect on the species in the long term. Older regrowth is just as supportive of the species as old growth. *T. lamproides* has thus been able to recolonise areas as they have aged. The age of the forest at which *T. lamproides* populations redevelop to their prelogging levels is not known precisely. From the regrowth examined in this study it appears to be greater than 30 years and less than 60 years. Population levels may be influenced by the build up of the litter layer and consequent increase in invertebrate numbers. Brown and Nelson (1992) state that at least 50 years is required before litter is consistently well-developed in wet forest regrowth after logging and burning in Victoria.

A pronounced concentration of *T. lamproides* was found in the northern sites. This finding is further supported by subsequent searches by M. Mahoney (pers. comm.) in the Redpa area, which is further south but classified as being similar to the forest in the north of the Togari block. This work did not produce numbers *of T. lamproides* equivalent to that of the northern sites in Togari. Searches undertaken by Bob Mesibov (pers. comm.) also suggest *T. lamproides* is more common in the north of the block. It is possible that this geographical anomaly is produced by more favourable climate in the northern areas, but there is no evidence for this. It does not appear to be controlled by slope as the most productive sites varied in their aspect. No conclusive explanation for the differences exists at present.

The constraints restricting *T. lamproides* to such a small range are not clear. To the east it may be out-competed by *T. sinclairi*. To the south it is possible that it becomes less common as areas become too cold for either it or some section of its diet to survive. Within its limited range it is apparently neither particularly rare nor abnormally sporadic, and it appears to be, if anything, more tolerant than most snail species. It should be regarded as a species with a naturally limited range but not otherwise rare.

Within the Togari block, *T. lamproides* was reliably present in small numbers over a wide range of available habitats. *T. lamproides* was surprisingly consistent in its presence, being located at 72% of the sites. This compares favourably with all bar one of the other snail species present in the block, and also compares favourably with similar species in other areas of Tasmania. For example, the success rate at finding *T. sinclairi* in suitable habitat over searches of similar or greater extent to the sites searched in the present study is only 62% (K. Bonham, unpubl. data) and *T. sinclairi* occurs much more widely than *T. lamproides*, its known range including about 60% of Tasmania. The consistency with which *T. lamproides* occurs in the Togari block suggests that it is a quite tolerant species and that its perceived rarity is due mainly to its limited distribution and cryptic nature. The only identifiable threat to the species comes from destruction of habitat through logging, fire or clearing. The majority of the range of the species occurs on State forest and hence forest cover is expected to be maintained on these areas in the long term, although the species would probably be locally eliminated by plantation development. Since it reinvades regenerating native forest over time, the status of the species in the future will be determined by the proportion and degree of interconnection of native forest present which is 50 or more years of age, particularly in the northern section of the Togari block.

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Literature cited

Brown, G.W. and Nelson, J.L. 1992 Habitat utilisation by heliothermic reptiles of different successional stages of *Eucalyptus regnans* Mountain Ash forest in the Central Highlands, Victoria. Silvicultural Systems Project Report No. 17. Department of Conservation and Natural Resources, Melbourne.

Cox, J.C. 1868. A monograph of Australian land shells. W. Maddock, Sydney.

Madden, J.L., Hickman, J.L. Richardson, A.M.M. and Hill, L. 1976. Effect of cutting and regeneration practice on the invertebrate fauna of litter and soil. Pp 1–18. Woodchip Symposium Papers. 47Th A.N.Z.A.A.S. Congress. Tasmanian Forestry Commission, Hobart.

Neumann, F.G. 1991. Responses of litter arthropods to major natural or artificial ecological disturbances in mountain ash forests. Australian Journal of Ecology 16: 19–32.

Petterd, W.F. 1879. A monograph of the land shells of Tasmania. Privately published, Launceston.

Petterd, W.F. and Hedley, C. 1909. A revised census of the terrestrial Mollusca of Tasmania. Records of the Australian Museum 7: 283–304.

Smith, B.J. 1992. Non-marine Mollusca. In: Houston, W.W. Zoological Catalogue of Australia Vol.8. Australian Government Publishing Service, Canberra. 405 pp.

Smith, B.J. and Kershaw, R.C. 1981. Tasmanian land and freshwater molluscs. Fauna of Tasmania Handbook No. 5. University of Tasmania, Hobart.

Note added in proof: In February 1997 *Tasmaphena lamproides* was located by K.B. in two small areas of wet eucalypt forest on Three Hummock Island in Bass Strait. The specimens found were slightly smaller and had a darker shell colour than Tasmanian mainland specimens. Searches for the species on King Island (December 1996), Hunter Island (January 1997) and Robbins Island (February 1997) were unsuccessful.